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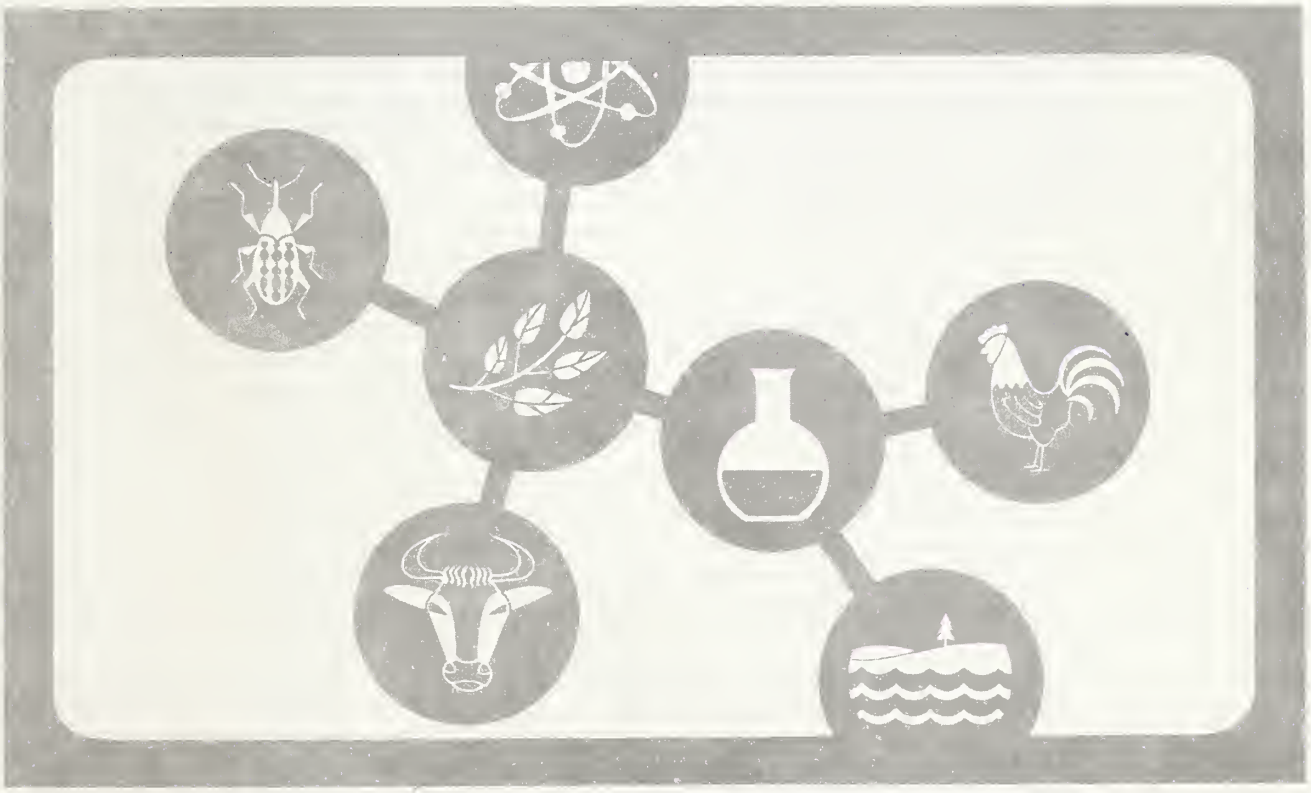
Effects of Cotton Genotype and Early or No Insecticide Treatment on Abundance of Selected Cotton Insects in the Mississippi Delta



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This publication is available from the Crop Science and Engineering Research Laboratory, P.O. Box 5367, Mississippi State, Miss. 39762.

The data in this publication were collected in the summer of 1976. The information is relevant to current conditions in cotton-pest control because of the intense emphasis on reducing insecticide applications for control of these pests and increasing the use of their parasites and predators.

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Effects of Cotton Genotype and Early or No Insecticide Treatment on Abundance of Selected Cotton Insects in the Mississippi Delta

By W. L. Parrott,[1] W. R. Meredith, Jr.,[2] J. N. Jenkins,[3] and J. C. McCarty, Jr.[4]

ABSTRACT

Insects were vacuum-sampled weekly until the end of July 1976 at four locations in field plots planted to five cotton varieties and one cotton strain. The insects were classified and counted, and counts were also made of *Heliothis* spp. eggs and worms on plant terminals and squares, respectively. The percentage of worm-damaged squares was also determined for each location. Insecticides were applied in half the plots at the rate of 0.2 pound (active ingredient) per acre for control of early-season pests. Early insecticide treatment resulted in a significant reduction in the number of some beneficial insects and pests. Predator populations varied among the locations and were never consistent. Insect numbers differed on certain varieties, whether or not the variety had received early insecticide treatment. The tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), reached the economic level at two locations, thus causing a reduction in lint cotton in the unsprayed plots; however, early spraying controlled this insect in other plots. *Heliothis* spp. larvae reached the economic level in unsprayed plots at one location, which suggests that beneficial insects alone are not able to control these pests. Index terms: cotton, cotton genotypes, *Heliothis* spp., insecticide treatments, insect populations, insect sampling, *Lygus lineolaris* (Palisot de Beauvois), Mississippi Delta.

INTRODUCTION

The basic insect-control methods for cotton, scouting or treating with insecticides, have not changed much in the past 30 years. One may well ask if entomologists have advanced the knowledge of insect control at all during this period. A review of the literature will reveal that approximately 30 years ago, immediately following the release of the chlorinated hydrocarbon insecticides for the control of cotton pests, the occurrence of some unusual insect outbreaks suggested that these new compounds

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might be detrimental to the natural enemies of certain cotton pests. Newsom and Smith (1949) reported that the chlorinated hydrocarbon insecticides did have a detrimental influence on the natural balance that exists among the cotton aphid, spider mites, and bollworm.

Ullyett (1948) suggested that a combination of insecticide treatment and biological control was, perhaps, the most satisfactory method of combating insect pests. Realistically, what other control methods are being suggested for use today that were not proposed 30 years ago? With various approaches being used to control cotton pests and with some researchers feeling that early applications of insecticides destroy beneficial insects, a study in this area seemed advisable.

The population peaks of several predaceous insects on cotton pests occur early in the season. Dinkins et al. (1970) reported that the great majority of the predator groups and species were present in early season. Campbell and Hutchins (1952) found that the peak predator population occurred in June, with the lowest ebb in mid-July.

Population counts of several major groups of beneficial arthropods in fields of both cotton and soybeans were reported by Pitre et al. (1978) to have reached a peak between mid-June and mid-July. Early applications of insecticides would therefore destroy many of these natural enemies of cotton pests. In fact, Laster and Brazzel (1968) compared predator populations in cotton under a complete chemical control program in which applications of insecticides were made on an automatic schedule along with those applied on an as-needed basis. They concluded that predaceous insects were conserved by applying insecticides only as needed.

The objectives of this study in 1976 were to determine (1) the effect of early applications of insecticides on the abundance of predators, cotton pests, parasites, and spiders; (2) the influence of different genotypes of cotton on insect abundance; and (3) the effect of beneficial insects on pest species under an early-spray and no-spray program. This is the first study to report both quantitative and qualitative data on beneficial cotton insects under two management systems, early application of insecticide versus no application, in the Mississippi Delta.

Table 1.—Example of analysis of data for Scott, Miss.[1]

Source of variation	d.f.[2]	Lady beetles	*Geocoris* spp.	Nabids	White-marked flea-hopper	Tarnished plant bug	cotton flea-hopper	*Chrysopa* spp.	*Orius insidiosus*	Leaf-hoppers	White-flies	Thrips
Replication	3	....	....	....	....	....	....	....	....	....	....	....
Treatment (T)	1	**	*	....	*	*	....	....	....	....	*	....
Error a	3	....	....	....	....	....	....	....	....	....	....	....
Variety (V)	5	**	....	*	....	*	....	....	....	....	....	*
$T \times V$	5	....	....	....	....	....	....	....	....	....	....	....
Error b	30	....	....	....	....	....	....	....	....	....	....	....
Date (D)	8	**	**	**	**	**	**	....	**	**	**	**
$T \times D$	8	....	**	**	**	**	....	....	....	**	**	....
$V \times D$	40	....	....	....	....	....	....	....	*	....	....	**
$V \times T \times D$	40	....	....	....	....	....	....	....	....	....	....	....
Error c	288	....	....	....	....	....	....	....	....	....	....	....
Total	431	....	....	....	....	....	....	....	....	....	....	....

[1]Each insect was analyzed separately. 1 asterisk indicates a significant F value at the 5% level. 2 asterisks indicate a significant F value at the 1% level.

[2]Degrees of freedom.

Table 2.—Dates of insecticide application at four locations

Location	Dates					
Scott	May 3	May 21	June 10	June 14	June 23	June 29
Shelby	.....	May 26	June 7	June 14	June 23	June 29
Sumner	.....	May 26	June 7	June 14	June 23	June 29
Stoneville	.....	.....	June 10	.....	June 24	June 29

MATERIALS AND METHODS

Four fields were selected for the study. They were located at Scott (S. Bolivar County), Shelby (N. Bolivar County), Sumner (Tallahatchie County), and Stoneville (Washington County).

Five cultivars of cotton, 'Deltapine 16' ('DPL 16' nectaried and 'DPL 7146N' nectariless), 'Stoneville 213' ('ST 213' nectaried and 'ST 731N' nectariless), and 'Coker 420' (smooth), and one advanced breeding strain, Missouri High Gossypol (MoHG), were planted April 13 at Scott, April 21 at Shelby, May 11 at Sumner, and May 20 at Stoneville.

The experiment, which was replicated four times, consisted of a split-split plot arrangement in a randomized complete block design. Whole plots were early and no insecticide treatment, split plots were cotton varieties, and split-split plots were dates. The plots consisted of sixteen 100-foot rows at Shelby and Sumner and sixteen 50-foot rows at Scott and Stoneville.

Sampling of insects was begun when plants had developed to the first true leaf stage and was continued weekly until the last week in July. Samples were taken on nine different sampling dates at Scott, Shelby, and Sumner but on only six dates at Stoneville because of the late planting date. Samples were taken with the Dietrick (1961) vacuum sampler (D-Vac) by placing the 0.31-meter-diameter cone vertically over the cotton. This was repeated until 25 samples were taken in each plot from each replication. The collected samples were placed in 5 gallon cans, fumigated with calcium cyanide, and carried to the laboratory and stored in a freezer until they were classified and counted.

The data for several insect species (those selected as most significant) were analyzed for each location as a split-split plot, with dates being the last split. Sources of variation were partitioned in accordance with table 1 for these insects at each location.

We began to examine the plant terminals and record egg counts for *Heliothis* spp. on June 2 at Scott, on June 17 at Sumner, and on June 22 at Shelby and Stoneville. Counts of worms (*Heliothis* spp.) and damaged squares were begun on July 13 at all locations.

Insecticides, dicrotophos (Bidrin) or monocrotophos (Azodrin),[5] were applied with a high-clearance sprayer at the recommended rate of 0.2 pound (active ingredient) per acre for control of the early-season pests, mainly thrips, fleahoppers, and plant bugs. The dates of application are shown in table 2.

The plots were harvested twice. The first and second harvests at Scott were on September 10 and October 15, at Shelby on September 23 and November 1, at Stoneville on September 30 and November 1, and at Sumner on September 24 and November 3. Boll samples were harvested at each harvest. After each harvest, the cotton was ginned, and the yields were recorded as lint cotton.

RESULTS AND DISCUSSION

Insect Samples

The following 45 species or groups of cotton pests, predators, parasites, and arachnids were recorded during the study:

Insect pests:
- Tarnished plant bug:
  - *Lygus lineolaris* (Palisot de Beauvois); adults and immatures.
- Cotton fleahopper:
  - *Pseudatomoscelis seriatus* (Reuter); adults and immatures.

[5]Dicrotophos, dimethyl phosphate ester of (*E*)-3-hydroxy-*N*,*N*-dimethylcrotonamide. Monocrotophos, dimethyl phosphate ester with (*E*)-3-hydroxy-*N*-methylcrotonamide.

Clouded plant bug:
Neurocolpus nubilus (Say); adults and immatures.
Whitemarked fleahopper:
Spanagonicus albofasciatus (Reuter); adults and immatures.
Boll weevil:
Anthonomus grandis (Boheman); adults.
Flea beetles: Chrysomelidae; adults.
Whiteflies: Aleyrodidae; adults.
Bollworm/budworm:
Heliothis spp.; immatures and eggs.
Leafhoppers: Delphacidae; adults:
Empoasca spp.; adults.
Graminella nigrifrons (Forbes); adults.
Graphocephala versuta (Say); adults.
Macrosteles fascifrons (Stal); adults.
Other leafhoppers; adults, immatures.
Aphids: Aphididae; adults and immatures.
Thrips: Thripidae; adults and immatures.
Predaceous insects:
Lady beetles:
Coleomegilla maculata (DeGeer); adults and immatures.
Hippodamia convergens Guérin-Méneville; adults and immatures.
Scymnus terminatus (Say); adults.
Scymnus loewii Mulsant; adults.
Other *Scymnus* spp.; adults.
Bigeyed bugs:
Geocoris punctipes (Say); adults and immatures.
Geocoris uliginosus (Say); adults and immatures.
Damsel bugs:
Tropiconabis capsiformis (Germar); adults and immatures.
Reduviolus alternatus (Parsley); adults and immatures.
Reduviolus roseipennis (Reuter); adults and immatures.
Hoplistoscelis deceptivus (Harris); adults and immatures.
Hoplistoscelis sordidus (Reuter); adults and immatures.
Green lacewings:
Chrysopa carnea Stephens; adults.
Chrysopa oculata Say; adults.
Chrysopa rufilabris Burmeister; adults.
Other *Chrysopa* spp.; immatures.
Brown lacewing:
Micromus subanticus (Walker); adults and immatures.
Minute pirate bug:
Orius insidiosus (Say); adults and immatures.
Soldier beetles:
Chauliognathus spp.; adults.
Syrphid flies: Syrphidae; adults.
Parasitic insects:
Microplitis croceipes (Cresson); adults.
Cardiochiles nigriceps Vieveck; adults.
Campoletes spp.; adults.
Apanteles spp.; adults.
Spiders:
Green lynx spider:
Peucetia viridans (Hentz); adults.

Counts of Selected Insects

Location effects.—Based on insect counts of the more significant species listed above, the highest numbers of insects were collected at Scott and Stoneville, followed by Shelby and Sumner (tables 3–6). In addition, larval counts for *Heliothis* spp. were highest at Sumner, moderately high at Stoneville, and very low at Scott and Shelby (table 7). As we considered the individual species or groups of insects, there were marked differences among locations. Whitemarked fleahoppers, tarnished plant bugs, whiteflies, and leafhoppers were in abundance at Scott and Stoneville. Lady beetles, *Orius insidiosus*, and thrips were also abundant at Scott. At Shelby, whiteflies and thrips were abundant. Only whiteflies and *Heliothis* spp. were abundant at Sumner. *Geocoris* spp., nabids, *Chrysopa* spp., and cotton fleahoppers were virtually nonexistent at all locations.

Seasonal abundance of insects.—Based upon data from the unsprayed plots, *Geocoris* spp., nabids, whitemarked fleahoppers, tarnished plant bugs, *Chrysopa* spp., and whiteflies reached peak numbers in mid-to-late July at all locations (tables 8–11). Allowing for differences in numbers among insects as well as locations, most of these populations increased slowly until mid-to-late July and then decreased markedly. Thrips reached peak abundance the first week of June. *Orius insidiosus* reached peak numbers in early July, whereas lady beetle populations were highest in mid-July.

(*Continued on page 21.*)

Table 3.—Number of predators and cotton pests collected per acre on six cotton varieties with and without early applications of insecticide, Scott, Miss., 1976

Treatment	Mean number of insects per acre for—						Treatment mean[2]	LSD[3]	
	'DPL 16'	'DPL 7146N'	'ST 213'	'ST 731N'	'Coker 420'	MoHG[1]		$V \times T$	V
				Lady beetles					
No spray	1,742	1,118	1,394	987	1,713	1,364	1,387*	ns	.....
Spray	1,379	1,118	1,205	668	1,147	1,437	1,159	ns	.....
Variety mean	1,561	1,118	1,300	828	1,430	1,401	.....	.....	370
				Geocoris spp.					
No spray	145	189	305	189	116	131	179*	ns	.....
Spray	116	58	87	102	0	145	85	ns	.....
Variety mean	131	123	196	145	58	138	.....	.....	ns
				Nabids					
No spray	261	465	378	218	319	174	302	ns	.....
Spray	378	305	363	58	203	160	244	ns	.....
Variety mean	319	385	370	138	261	167	.....	.....	146
				Whitemarked fleahopper					
No spray	1,771	1,031	1,307	2,163	1,321	1,583	1,529*	ns	.....
Spray	552	755	987	1,133	319	682	738	ns	.....
Variety mean	1,162	893	1,147	1,648	820	1,133	.....	.....	ns
				Tarnished plant bug					
No spray	2,251	1,830	2,759	1,452	2,192	1,815	2,020*	ns	.....
Spray	1,220	900	1,394	1,172	1,365	1,321	1,229	ns	.....
Variety mean	1,735	1,365	2,076	1,314	1,779	1,568	.....	.....	500
				Cotton fleahopper					
No spray	290	203	290	348	363	436	322	ns	.....
Spray	131	116	73	203	116	203	140	ns	.....
Variety mean	211	160	181	276	240	319	.....	.....	ns
				Chrysopa spp.					
No spray	102	58	29	58	131	116	82	ns	.....
Spray	174	29	102	73	15	87	80	ns	.....
Variety mean	138	44	65	65	73	102	.....	.....	ns
				Orius insidiosus					
No spray	1,902	1,830	1,728	1,393	1,830	1,597	1,713	ns	.....
Spray	247	566	494	392	276	653	438	ns	.....
Variety mean	1,075	1,198	1,111	893	1,053	1,125	.....	.....	ns

See footnotes at end of table.

Table 3.—Number of predators and cotton pests collected per acre on six cotton varieties with and without early applications of insecticide, Scott, Miss., 1976—Continued

Treatment	Mean number of insects per acre for—						Treatment mean[2]	LSD[3]	
	'DPL 16'	'DPL 7146N'	'ST 213'	'ST 731N'	'Coker 420'	MoHG[1]		$V \times T$	V
					Leafhoppers				
No spray	7,304	9,772	7,144	5,009	5,692	8,886	7,301	ns	.....
Spray	1,554	2,004	1,583	1,844	1,554	2,120	1,776	ns	.....
Variety mean	4,429	5,888	4,363	3,427	3,623	5,503	.....	.....	ns
					Whiteflies				
No spray	10,004	8,697	9,656	7,216	7,623	10,193	8,898	ns	.....
Spray	4,748	5,009	9,177	6,113	3,703	7,173	5,987	ns	.....
Variety mean	7,376	6,853	9,416	6,665	5,663	8,683	.....	.....	ns
					Thrips				
No spray	2,381	1,554	3,325	3,296	1,583	4,487	2,771	ns	.....
Spray	2,222	1,205	1,525	2,643	1,452	2,991	2,006	ns	.....
Variety mean	2,301	1,379	2,425	2,969	1,517	3,739	.....	.....	1,374

[1]MoHG is a cotton strain.

[2]An asterisk after a number indicates significant difference at the 5% level between spray and no spray.

[3]LSD=least significant difference, calculated only where effect was significant in analysis of variance. *V*=variety. *T*=treatment. ns=no significant difference at the 5% level. Differences in variety means in a row equal to or greater than a value in these columns for the same row are significant at the 5% level.

Table 4.—Number of predators and cotton pests collected per acre on six cotton varieties with and without early applications of insecticide, Shelby, Miss., 1976

Treatment	Mean number of insects per acre for—						Treatment mean[2]	LSD[3]	
	'DPL 16'	'DPL 7146N'	'ST 213'	'ST 731N'	'Coker 420'	MoHG[1]		$V \times T$	V
					Lady beetles				
No spray	421	261	189	116	334	218	256	ns	.....
Spray	363	247	276	131	174	261	242	ns	.....
Variety mean	392	254	232	123	254	240	.....	.....	ns
					Geocoris spp.				
No spray	73	73	29	0	87	15	46	ns	.....
Spray	15	29	15	29	29	29	24	ns	.....
Variety mean	44	51	22	15	58	22	.....	.....	ns
					Nabids				
No spray	276	58	160	58	102	29	114	157	.....
Spray	58	174	218	0	44	29	87	157	.....
Variety mean	167	116	189	29	73	29	.....	.....	111

See footnotes at end of table.

Table 4.—Number of predators and cotton pests collected per acre on six cotton varieties with and without early applications of insecticide, Shelby, Miss., 1976—Continued

Treatment	Mean number of insects per acre for—						Treatment mean[2]	LSD[3]	
	'DPL 16'	'DPL 7146N'	'ST 213'	'ST 731N'	'Coker 420'	MoHG[1]		$V \times T$	V
					Whitemarked fleahopper				
No spray	73	378	247	290	421	610	336	ns	
Spray	87	102	174	653	174	552	290	ns	
Variety mean	80	240	211	472	298	581			218
					Tarnished plant bug				
No spray	537	160	261	319	697	232	368	ns	
Spray	407	334	247	203	334	203	288	ns	
Variety mean	472	247	254	261	515	218			166
					Cotton fleahopper				
No spray	0	15	15	15	0	0	7	ns	
Spray	0	0	0	15	0	15	5	ns	
Variety mean	0	7	7	15	0	7			ns
					Chrysopa spp.				
No spray	87	0	44	44	189	0	60	ns	
Spray	131	44	44	44	58	44	60	ns	
Variety mean	109	22	44	44	123	22			ns
					Orius insidiosus				
No spray	828	334	392	145	392	116	368	ns	
Spray	305	421	218	131	261	232	261	ns	
Variety mean	566	378	305	138	327	174			ns
					Leafhoppers				
No spray	1,350	958	711	1,060	653	741	915*	ns	
Spray	1,016	1,307	1,016	1,234	1,263	1,249	1,181	ns	
Variety mean	1,183	1,133	864	1,147	958	995			ns
					Whiteflies				
No spray	5,793	3,132	4,487	4,461	3,499	5,823	4,066	ns	
Spray	4,167	2,991	4,487	4,893	4,051	3,906	4,083	ns	
Variety mean	4,980	3,361	4,487	4,777	3,775	4,864			ns
					Thrips				
No spray	9,046	6,650	9,307	10,266	9,104	7,391	8,627	ns	
Spray	11,093	10,977	10,280	9,206	9,757	10,077	10,232	ns	
Variety mean	10,069	8,814	9,794	9,736	9,431	8,734			ns

[1]MoHG is a cotton strain.

[2]An asterisk after a number indicates significant difference at the 5% level between spray and no spray.

[3]LSD=least significant difference, calculated only where effect was significant in analysis of variance. *V*=variety. *T*=treatment. ns=no significant difference at the 5% level. Differences in variety means in a row equal to or greater than a value in these columns for the same row are significant at the 5% level.

Table 5.—Number of predators and cotton pests collected per acre on six cotton varieties with and without early applications of insecticide, Sumner, Miss., 1976

Treatment	Mean number of insects per acre for—						Treatment mean	LSD[2]	
	'DPL 16'	'DPL 7146N'	'ST 213'	'ST 731N'	'Coker 420'	MoHG[1]		$V \times T$	V
					Lady beetles				
No spray	378	436	73	116	160	189	225	234	.....
Spray	174	174	203	87	407	131	196	234	.....
Variety mean	276	305	138	102	283	160	.....	.....	166
					Geocoris spp.				
No spray	0	0	0	0	0	0	0	ns	.....
Spray	0	0	0	0	0	0	0	ns	.....
Variety mean	0	0	0	0	0	0	.....	.....	ns
					Nabids				
No spray	0	44	29	0	0	0	12	ns	.....
Spray	44	0	73	15	29	15	29	ns	.....
Variety mean	21	21	51	7	15	7	.....	.....	ns
					Whitemarked fleahopper				
No spray	116	174	44	73	44	58	85	ns	.....
Spray	58	44	73	73	58	87	65	ns	.....
Variety mean	87	109	58	73	51	73	.....	.....	ns
					Tarnished plant bug				
No spray	29	44	0	58	15	73	36	ns	.....
Spray	0	58	15	15	44	15	24	ns	.....
Variety mean	15	51	7	36	29	44		.....	ns
					Cotton fleahopper				
No spray	0	0	0	0	0	0	0	ns	.....
Spray	0	0	0	0	0	0	0	ns	.....
Variety mean	0	0	0	0	0	0	.....	.....	ns
					Chrysopa spp.				
No spray	15	73	58	15	58	73	48	77	.....
Spray	44	29	58	0	203	44	63	77	.....
Variety mean	29	51	58	7	131	58	.....	.....	35
					Orius insidiosus				
No spray	15	44	0	0	29	0	15	ns	.....
Spray	0	0	0	0	29	73	17	ns	.....
Variety mean	7	22	0	0	29	36	.....	.....	ns

See footnotes at end of table.

Table 5.—Number of predators and cotton pests collected per acre on six cotton varieties with and without early applications of insecticide, Sumner, Miss., 1976—Continued

Treatment	Mean number of insects per acre for—						Treatment mean	LSD[2]	
	'DPL 16'	'DPL 7146N'	'ST 213'	'ST 731N'	'Coker 420'	MoHG[1]		$V \times T$	V
					Leafhoppers				
No spray	436	624	378	247	450	1,800	656	ns	
Spray	479	247	421	799	668	305	486	ns	
Variety mean	457	436	399	523	559	1,053			ns
					Whiteflies				
No spray	8,015	10,512	16,887	61,013	5,677	42,384	24,081	ns	
Spray	7,173	7,202	17,410	72,266	14,026	43,226	26,884	ns	
Variety mean	7,594	8,857	17,148	66,640	9,852	42,805			16,229
					Thrips				
No spray	160	261	203	290	58	232	201	ns	
Spray	218	131	189	189	247	218	198	ns	
Variety mean	189	196	196	240	152	225			ns

[1]MoHG is a cotton strain.

[2]LSD=least significant difference, calculated only where effect was significant in analysis of variance. V=variety. T=treatment. ns=no significant difference at the 5% level. Differences in variety means in a row equal to or greater than a value in these columns for the same row are significant at the 5% level.

Table 6.—Number of predators and cotton pests collected per acre on six cotton varieties with and without early applications of insecticide, Stoneville, Miss., 1976

Treatment	Mean number of insects per acre for—						Treatment mean[2]	LSD[3]	
	'DPL 16'	'DPL 7146N'	'ST 213'	'ST 731N'	'Coker 420'	MoHG[1]		$V \times T$	V
					Lady beetles				
No spray	588	675	457	327	806	501	559	ns	
Spray	479	261	414	65	348	152	287	ns	
Variety mean	534	468	436	196	577	327			ns
					Geocoris spp.				
No spray	0	22	109	218	109	65	87	ns	
Spray	22	44	22	22	22	22	25	ns	
Variety mean	11	33	65	120	65	44			ns
					Nabids				
No spray	915	479	1,198	762	741	675	795	ns	
Spray	174	1,546	218	305	240	196	447	ns	
Variety mean	545	1,013	708	534	490	436			ns

See footnotes at end of table.

Table 6.—Number of predators and cotton pests collected per acre on six cotton varieties with and without early applications of insecticide, Stoneville, Miss., 1976—Continued

Treatment	Mean number of insects per acre for—						Treatment mean[2]	LSD[3]	
	'DPL 16'	'DPL 7146N'	'ST 213'	'ST 731N'	'Coker 420'	MoHG[1]		$V \times T$	V
					Whitemarked fleahopper				
No spray	21,148	13,460	15,682	17,881	13,896	17,620	16,614*	ns	.....
Spray	3,877	2,134	4,225	2,940	2,831	3,833	3,307	ns	.....
Variety mean	12,513	7,797	9,953	10,411	8,364	10,727	.....	.....	ns
					Tarnished plant bug				
No spray	2,897	2,113	3,180	2,222	3,027	2,222	2,610*	ns	.....
Spray	784	414	849	632	479	675	639	ns	.....
Variety mean	1,840	1,263	2,015	1,427	1,753	1,448	.....	.....	ns
					Cotton fleahopper				
No spray	22	22	44	22	87	22	36	ns	.....
Spray	22	22	0	0	22	0	11	ns	.....
Variety mean	22	22	22	11	54	11	.....	.....	ns
					Chrysopa spp.				
No spray	65	109	196	261	174	44	142	ns	.....
Spray	22	22	22	22	65	44	33	ns	.....
Variety mean	44	65	109	142	120	44	.....	.....	ns
					Orius insidiosus				
No spray	457	566	697	545	719	261	541*	ns	.....
Spray	131	261	109	218	261	22	167	ns	.....
Variety mean	294	414	403	381	490	142	.....	.....	ns
					Leafhoppers				
No spray	5,293	4,596	5,401	3,202	4,748	5,793	4,839*	ns	.....
Spray	2,243	2,461	1,568	2,940	2,352	2,069	2,272	ns	.....
Variety mean	3,768	3,528	3,485	3,071	3,550	3,931	.....	.....	ns
					Whiteflies				
No spray	12,262	10,106	9,975	17,446	9,278	7,492	11,093	4,463	.....
Spray	6,033	6,055	6,186	13,024	8,516	15,137	9,158	4,463	.....
Variety mean	9,148	8,080	8,080	15,235	8,897	11,315	.....	.....	3,156
					Thrips				
No spray	109	174	218	0	22	65	98	ns	.....
Spray	0	0	0	22	174	87	47	ns	.....
Variety mean	54	87	109	11	98	76	.....	.....	ns

[1]MoHG is a cotton strain.

[2]An asterisk after a number indicates significant difference at the 5% level between spray and no spray.

[3]LSD=least significant difference, calculated only where effect was significant in analysis of variance. *V*=variety. *T*=treatment. ns=no significant difference at the 5% level. Differences in variety means in a row equal to or greater than a value in these columns for the same row are significant at the 5% level.

Table 7.—Number of cotton pests and their predators collected per acre and percentage of damaged squares without insecticide applications at four locations, 1976

Pest, predator, or cotton damage	May		June					July				August			
	18	26	2	8	17	22	29	6	13	20	28	3	10	17	24
Scott															
Lygus bugs	44	22	152	87	2,070	3,944	3,225	3,788	5,034	.....	.....	.....	.....	.....	.....
Predators of lygus bugs[1]	0	66	65	44	741	566	915	1,068	871	.....	.....	.....	.....	.....	.....
Heliothis eggs[2]	.....	.....	0	0	0.16	1.52	0	0	0	0	0	0	0	0.24	0
Predators of *Heliothis* eggs[3]	22	262	1,220	589	1,438	2,309	3,527	4,358	3,813	.....	.....	.....	.....	.....	.....
Heliothis larvae[4]	.....	.....	.....	.....	.....	.....	.....	.....	0.08	0	0	0	0.16	0	0.25
Predators of *Heliothis* larvae[5]	0	153	261	44	741	479	632	806	588	.....	.....	.....	.....	.....	.....
Percentage of worm-damaged squares	.....	.....	.....	.....	.....	.....	.....	.....	0.46	1.08	0.08	0.25	0.17	0.4	0.33
Shelby															
Lygus bugs	.....	0	0	22	.....	370	153	588	915	1,090	174	.....	.....	.....	.....
Predators of lygus bugs[1]	.....	0	0	0	.....	44	87	65	240	632	175	.....	.....	.....	.....
Heliothis eggs[2]	.....	.....	.....	.....	.....	0	0	0	0	0.41	0	0.41	1.17	1.08	0.08
Predators of *Heliothis* eggs[3]	22	174	153	.....	.....	131	262	631	458	1,008	1,003	.....	.....	.....	.....
Heliothis larvae[4]	.....	.....	.....	.....	.....	.....	.....	.....	0.42	0.33	0.08	0.08	1.00	0.92	0.08
Predators of *Heliothis* larvae[5]	.....	0	0	0	.....	44	131	65	240	632	175	.....	.....	.....	.....
Percentage of worm-damaged squares	.....	.....	.....	.....	.....	.....	.....	.....	4.70	3.92	0.58	0.29	2.29	4.54	3.54
Stoneville															
Lygus bugs	.....	.....	.....	.....	.....	1,220	458	2,942	3,791	3,247	4,010	.....	.....	.....	.....
Predators of lygus bugs[1]	.....	.....	.....	.....	.....	109	109	327	632	2,571	1,548	.....	.....	.....	.....
Heliothis eggs[2]	.....	.....	.....	.....	.....	0	0	0.40	0.32	0	0.25	0.53	0.58	1.00	17.40
Predators of *Heliothis* eggs[3]	.....	.....	.....	.....	.....	545	501	1,460	1,090	3,378	2,529	.....	.....	.....	.....
Heliothis larvae[4]	.....	.....	.....	.....	.....	.....	.....	.....	0.12	0.04	0	0	0.70	0.58	0.41
Predators of *Heliothis* larvae[5]	.....	.....	.....	.....	.....	109	109	327	632	2,571	1,548	.....	.....	.....	.....
Percentage of worm-damaged squares	.....	.....	.....	.....	.....	.....	.....	.....	0.25	1.75	0.20	0.50	2.20	2.66	2.54
Sumner															
Lygus bugs	.....	.....	0	0	22	44	0	22	109	131	0	.....	.....	.....	.....
Predators of lygus bugs[1]	.....	.....	0	0	22	0	22	22	44	22	0	.....	.....	.....	.....
Heliothis eggs[2]	.....	.....	.....	.....	0	0	0	1.25	0.58	35.08	0.08	1.58	1.75	9.76	23.64
Predators of *Heliothis* eggs[3]	.....	.....	0	0	22	22	44	479	1,591	370	44	.....	.....	.....	.....
Heliothis larvae[4]	.....	.....	.....	.....	.....	.....	.....	.....	0.33	0.04	1.75	1.00	0.33	0.75	0.24
Predators of *Heliothis* larvae[5]	.....	.....	0	0	22	0	22	22	44	22	0	.....	.....	.....	.....
Percentage of worm-damaged squares	.....	.....	.....	.....	.....	.....	.....	.....	6.70	9.34	7.70	7.74	4.84	2.62	3.24

[1]Included *Geocoris* spp. and nabids. [2]Number of eggs per 100 terminals. [3]Included lady beetles, *Geocoris* spp., nabids, *Chrysopa* spp., and *Orius insidiosus*. [4]Number of larvae per 100 terminals. [5]Included *Geocoris* spp., nabids, and *Chrysopa* spp.

Table 8.—Number of predators and cotton pests collected per acre each week for 9 weeks with and without early applications of insecticide, Scott, Miss., 1976

Treatment	May 18	May 26	June 2	June 8	June 17	June 22	June 29	July 6	July 13	Treatment mean[1]	LSD[2] $D \times T$	LSD[2] Date
						Lady beetles						
No spray	22	65	959	523	588	1,634	2,568	3,203	2,855	1,380*	ns	
Spray	22	109	610	414	174	1,591	2,048	2,266	3,203	1,160		
Date mean	22	87	784	468	381	1,612	2,308	2,734	3,029			471
						Geocoris spp.						
No spray	0	44	0	22	305	196	327	349	370	179*	209	
Spray	0	44	0	0	0	392	174	87	65	85		
Date mean	0	44	0	11	152	294	250	218	217			157
						Nabids						
No spray	0	22	65	22	436	370	588	719	501	303ns	262	
Spray	0	65	22	65	218	893	501	218	218	244		
Date mean	0	43	43	43	327	631	544	468	359			157
						Whitemarked fleahopper						
No spray	0	283	1,634	676	1,722	1,874	2,724	2,048	2,811	1,530*	785	
Spray	0	196	545	697	828	1,155	1,307	370	1,547	738		
Date mean	0	239	1,089	687	1,275	1,514	2,016	1,209	2,179			575
						Tarnished plant bug						
No spray	44	22	153	87	2,070	3,944	3,225	3,879	5,034	2,051*	889	
Spray	22	87	109	327	1,046	4,315	2,005	1,547	6,113	1,230		
Date mean	33	55	131	207	1,558	4,129	2,615	2,713	3,324			628
						Cotton fleahopper						
No spray	0	240	240	153	327	763	436	392	349	322ns	ns	
Spray	0	22	174	109	22	523	196	65	153	140		
Date mean	0	131	207	131	175	643	316	229	251			157

						Chrysopa spp.						
No spray	0	131	196	22	109	87	44	65	87	82ns	ns	.....
Spray	0	44	262	65	44	44	22	65	174	80	.....	.....
Date mean .	0	88	229	44	77	66	33	65	131	.....	.....	105
						Orius insidiosus						
No spray	109	153	240	262	1,918	4,511	4,010	1,918	2,310	1,715ns	941	.....
Spray	65	44	65	196	22	872	1,416	479	785	438	.....	.....
Date mean .	67	99	153	229	970	2,692	2,713	1,199	1,548	.....	.....	680
						Leafhoppers						
No spray	2,005	697	2,550	1,504	17,695	19,351	6,341	7,344	8,259	7,305*	4,707	.....
Spray	1,199	414	893	959	1,678	2,789	3,661	2,332	2,070	1,777	.....	.....
Date mean .	1,602	556	1,722	1,232	10,242	11,070	5,001	4,838	5,165	.....	.....	3,347
						Whiteflies						
No spray	0	2,571	6,254	7,259	13,860	17,412	7,213	13,097	12,465	8,903*	3,896	.....
Spray	0	1,634	6,603	7,932	7,714	12,901	4,489	5,862	6,777	5,990	.....	.....
Date mean .	0	2,103	6,429	7,595	10,787	15,157	5,851	9,480	9,621	.....	.....	2,756
						Thrips						
No spray	65	2,811	17,302	2,419	1,438	479	153	153	131	2,772ns	ns	.....
Spray	87	414	15,385	1,286	719	131	44	0	0	2,007	.....	.....
Date mean .	76	1,613	16,344	1,853	1,079	305	99	77	66	.....	.....	1,674

[1]An asterisk after a number indicates significant difference at the 5% level between spray and no spray. ns=no significant difference at the 5% level.

[2]LSD=least significant difference, calculated only where effect was significant in analysis of variance. *D*=date. *T*=treatment. ns=no significant difference at the 5% level. Differences in date means in a row equal to or greater than a value in these columns for the same row are significant at the 5% level.

Table 9.—Number of predators and cotton pests collected per acre each week for 9 weeks with and without early applications of insecticide, Shelby, Miss., 1976

Treatment	May 26	June 3	June 9	June 23	July 1	July 8	July 14	July 21	July 28	Treatment mean[1]	LSD[2] $D \times T$	LSD[2] Date
						Lady beetles						
No spray	22	174	153	87	87	501	87	436	763	257ns	.....	.....
Spray	0	109	283	240	153	588	196	262	349	242	ns	.....
Date mean	11	142	218	164	120	545	142	349	556	.....	.....	157
						Geocoris spp.						
No spray	0	0	0	0	22	0	66	109	22	24ns	ns	.....
Spray	0	0	0	0	0	44	22	66	87	24	.....	.....
Date mean	0	0	0	0	11	22	44	88	55	.....	.....	52
						Nabids						
No spray	0	0	0	44	65	65	174	523	153	114ns	ns	.....
Spray	0	0	44	153	44	44	109	349	44	87	.....	.....
Date mean	0	0	22	99	55	55	142	436	99	.....	.....	157
						Whitemarked fleahopper						
No spray	0	44	0	22	87	131	283	1,177	1,286	337ns	ns	.....
Spray	0	22	0	22	0	87	262	1,002	1,220	291	.....	.....
Date mean	0	33	0	22	44	109	272	1,090	1,253	.....	.....	262
						Tarnished plant bug						
No spray	0	0	22	370	153	588	915	1,090	174	368ns	ns	.....
Spray	0	22	0	327	87	523	567	872	196	288	.....	.....
Date mean	0	11	11	349	120	556	741	981	185	.....	.....	209
						Cotton fleahopper						
No spray	0	0	0	0	0	0	22	22	22	7ns	ns	.....
Spray	0	0	0	0	22	0	22	0	0	5	.....	.....
Date mean	0	0	0	0	11	0	22	11	11	.....	.....	ns

						Chrysopa spp.						
No spray	0	0	0	0	44	65	131	240	65	61ns	ns	
Spray	0	22	22	0	44	44	131	131	153	61		
Date mean	0	11	11	0	44	55	131	186	109			105
						Orius insidiosus						
No spray	22	0	22	22	109	1,264	458	1,111	305	368ns	ns	
Spray	0	22	0	44	0	1,220	196	763	109	262		
Date mean	11	11	11	33	55	1,242	372	937	207			314
						Leafhoppers						
No spray	240	392	262	240	741	2,768	1,351	1,525	697	913*	785	
Spray	262	283	479	349	349	3,399	893	3,291	1,329	1,182		
Date mean	251	338	371	295	545	3,084	1,122	2,408	1,013			523
						Whiteflies						
No spray	218	1,133	1,460	1,765	1,678	3,203	4,729	15,843	11,985	4,668ns	2,913	
Spray	44	719	2,310	1,068	1,002	2,942	3,617	8,499	16,562	4,085		
Date mean	131	926	1,885	1,417	1,340	3,073	4,173	12,171	14,274			2,050
						Thrips						
No spray	3,879	72,087	1,591	131	0	0	0	0	0	8,632ns	6,590	
Spray	1,416	89,237	1,351	87	0	44	0	0	0	10,237		
Date mean	2,648	80,662	1,471	109	0	22	0	0	0			4,655

[1]An asterisk after a number indicates significant difference at the 5% level between spray and no spray. ns=no significant difference at the 5% level.

[2]LSD=least significant difference, calculated only where effect was significant in analysis of variance. $\bar{D}$=date. T=treatment. ns=no significant difference at the 5% level. Differences in date means in a row equal to or greater than a value in these columns for the same row are significant at the 5% level.

Table 10.—Number of predators and cotton pests collected per acre each week for 9 weeks with and without early applications of insecticide, Sumner, Miss., 1976

Treatment	June 3	June 9	June 18	June 23	July 1	July 8	July 14	July 21	July 28	Treatment mean[1]	LSD[2] $D \times T$	LSD[2] Date
						Lady beetles						
No spray	0	0	0	22	0	305	1,416	283	0	225ns	ns	
Spray	65	22	0	65	22	218	981	305	87	196		
Date mean	33	11	0	44	11	262	1,199	294	44			209
						Geocoris spp.						
No spray	0	0	0	0	0	0	22	0	0	2ns	ns	
Spray	0	0	0	0	22	22	0	0	0	5		
Date mean	0	0	0	0	111	11	11	0	0			ns
						Nabids						
No spray	0	0	22	0	22	22	22	22	0	12ns	ns	
Spray	0	0	0	0	22	44	153	44	0	29		
Date mean	0	0	11	0	22	33	88	33	0			52
						Whitemarked fleahopper						
No spray	22	0	22	0	22	22	305	349	22	85ns	ns	
Spray	0	0	65	44	0	44	218	218	0	65		
Date mean	11	0	44	22	11	33	262	284	11			105
						Tarnished plant bug						
No spray	0	0	22	44	0	22	109	131	0	36ns	ns	
Spray	0	0	0	22	0	44	109	22	22	24		
Date mean	0	0	11	33	0	33	109	77	11			52
						Cotton fleahopper						
No spray	0	0	22	0	0	0	0	0	0	2ns	ns	
Spray	0	0	0	0	0	0	22	0	0	2		
Date mean	0	0	11	0	0	0	11	0	0			ns

						Chrysopa spp.						
No spray	0	0	0	0	22	174	131	65	44	48ns	ns	
Spray	0	0	0	0	44	174	240	87	22	63		
Date mean	0	0	0	0	33	174	186	76	33			52
						Orius insidiosus						
No spray	0	0	0	0	0	109	22	0	0	15ns	ns	
Spray	0	0	0	44	65	44	0	0	0	17		
Date mean	0	0	0	22	33	77	11	0	0			ns
						Leafhoppers						
No spray	22	0	262	109	479	915	1,199	654	2,266	656ns	ns	
Spray	44	22	370	174	458	915	1,308	1,090	0	487		
Date mean	33	11	316	142	469	915	1,254	872	1,133			ns
						Whiteflies						
No spray	0	0	327	283	1,765	2,506	23,470	154,961	33,537	24,094ns	ns	
Spray	0	109	545	850	981	4,053	21,792	170,803	42,951	26,898		
Date mean	0	55	436	567	1,373	3,280	22,631	162,882	38,244			19,884
						Thrips						
No spray	1,242	458	109	0	0	0	0	0	0	201ns	ns	
Spray	1,286	458	44	0	0	0	0	0	0	199		
Date mean	1,264	458	77	0	0	0	0	0	0			105

[1] ns=no significant difference at the 5% level between spray and no spray.

[2] LSD=least significant difference, calculated only where effect was significant in analysis of variance. *D*=date. *T*=treatment. ns=no significant difference at the 5% level. Differences in date means in a row equal to or greater than a value in these columns for the same row are significant at the 5% level.

Table 11.—Number of predators and cotton pests collected per acre each week for 6 weeks with and without early applications of insecticide, Stoneville, Miss., 1976

Treatment	June 22	June 29	July 6	July 13	July 20	July 27	Treatment mean[1]	LSD[2]	
								$D \times T$	Date
				Lady beetles					
No spray	414	392	1,002	327	654	567	559ns	366	.....
Spray	567	109	370	87	131	458	287	.....	.....
Date mean	491	251	686	207	393	513	.....	.....	262
				Geocoris spp.					
No spray	44	44	153	44	87	153	88*	ns	.....
Spray		22	0	44	22	22	44	26	.....
Date mean	33	22	99	33	55	99	.....	.....	ns
				Nabids					
No spray	65	65	174	588	2,480	1,395	795ns	837	.....
Spray	981	196	327	262	633	283	447	.....	.....
Date mean	523	131	251	425	1,558	839	.....	.....	628
				Whitemarked fleahopper					
No spray	12,269	3,182	5,426	13,576	37,068	28,220	16,624*	5,700	.....
Spray	9,981	1,242	2,964	959	1,787	2,920	3,309	.....	.....
Date mean	11,125	2,212	4,195	7,268	19,428	15,570	.....	.....	4,027
				Tarnished plant bug					
No spray	1,220	458	2,942	3,791	3,247	4,010	2,611*	837	.....
Spray	436	218	1,525	545	218	893	639	.....	.....
Date mean	828	338	2,234	2,168	1,733	2,452	.....	.....	575
				Cotton fleahopper					
No spray	109	0	0	0	22	87	36ns	ns	.....
Spray	44	0	0	22	0	0	11	.....	.....
Date mean	77	0	0	11	11	44	.....	.....	ns
				Chrysopa spp.					
No spray	22	0	131	131	153	414	142ns	157	.....
Spray	0	0	65	0	44	87	33	.....	.....
Date mean	11	0	98	66	99	251	.....	.....	105
				Orius insidiosus					
No spray	588	22	1,111	822	392	262	541*	366	.....
Spray	305	65	545	65	22	0	501	.....	.....
Date mean	447	44	828	447	207	131	.....	.....	262

See footnotes at end of table.

Table 11.—Number of predators and cotton pests collected per acre each week for 6 weeks with and without early applications of insecticide, Stoneville, Miss., 1976—Continued

Treatment	June 22	June 29	July 6	July 13	July 20	July 27	Treatment mean[1]	LSD[2]	
								$D \times T$	Date
					Leafhoppers				
No spray	5,644	2,070	3,574	3,073	6,625	8,063	4,842*	2,563	.....
Spray	4,053	1,220	3,443	1,264	1,961	1,699	2,273	.....	.....
Date mean	4,849	1,645	3,509	2,169	4,293	4,881	.....	.....	11,831
					Whiteflies				
No spray	1,765	1,133	4,533	6,821	25,431	26,913	11,099ns	4,472	.....
Spray	1,656	632	3,639	4,489	13,298	31,271	9,164	.....	.....
Date mean	1,711	883	4,086	5,655	19,365	29,092	.....	.....	3,158
					Thrips				
No spray	479	44	0	0	65	0	98ns	ns	.....
Spray	283	0	0	0	0	0	47	.....	.....
Date mean	381	22	0	0	33	0	.....	.....	209

[1]An asterisk after a number indicates significant difference at the 5% level between spray and no spray, ns=no significant difference at the 5% level.

[2]LSD=least significant difference, calculated only where effect was significant in analysis of variance. *D*=date. *T*=treatment. ns=no significant difference at the 5% level. Differences in date means in a row equal to or greater than a value in these columns for the same row are significant at the 5% level.

Table 12.—Lint yields, in pounds per acre, for six cotton varieties with and without early applications of insecticide at four locations in the Mississippi Delta, 1976

Treatment	Scott			Shelby			Sumner			Stoneville		
	Total	1st harvest	Percentage of total at 1st harvest	Total[1]	1st harvest[1]	Percentage of total at 1st harvest	Total[1]	1st harvest[1]	Percentage of total at 1st harvest	Total	1st harvest	Percentage of total at 1st harvest
						'DPL 16'						
No spray	528	203	39	351	74	21	464	140	30	245	134	55
Spray	792	496	63	351	212	61	535	164	31	357	171	48
						'DPL 7146N'						
No spray	890	373	42	386	89	23	497	157	32	387	206	53
Spray	735	403	55	349	185	53	279	69	25	381	138	36
						'ST 213'						
No spray	817	208	26	449	117	26	394	60	15	199	81	41
Spray	630	297	47	459	233	51	419	77	18	462	267	58
						'ST 731N'						
No spray	795	332	42	404	112	28	345	56	16	369	185	50
Spray	832	426	51	337	130	39	374	39	11	313	172	55
						'COKER 420'						
No spray	485	176	36	301	89	30	476	207	44	122	62	51
Spray	675	390	58	254	144	57	591	162	27	305	150	49
						MoHG[2]						
No spray	548	185	34	274	96	35	415	171	41	203	126	62
Spray	564	474	84	215	136	64	369	159	43	353	268	76
LSD[3], 5% level.	160	127	.....	ns	ns	.....	ns	ns	.....	120	102	.....

[1]ns=no significant difference at the 5% level.
[2]MoHG is a cotton strain.
[3]LSD=least significant difference between any 2 values.

Early Insecticide Treatments

Three to six early applications of insecticide were made at each location, depending upon planting date. The last applications were made on June 29 at all locations. Early-season treatments did not affect insect abundance at Shelby and Sumner; however, all insect counts were very low at these locations, except for *Heliothis* spp. at Sumner. These treatments reduced the numbers of predators and also whiteflies, thrips, tarnished plant bugs, and leafhoppers at Scott and Stoneville. Cotton fleahoppers were also reduced in numbers at Scott, the only location where they were in abundance.

Data on earliness measured as percentage of yield at first harvest show significant increases resulting from early-season insecticide treatments at Scott and Shelby but not at the other two locations (table 12). Insect numbers were too low in D-Vac samples at Shelby to indicate which insects the insecticides were controlling. It may have been the control of tarnished plant bugs or thrips that contributed to the earliness of the sprayed plots. Leafhopper populations were higher on the sprayed plots and thus were not responsible for the earliness. At Scott, tarnished plant bugs, cotton fleahoppers, whitemarked fleahoppers, and leafhoppers were reduced in number by insecticide treatments. Since whitemarked fleahoppers and leafhoppers have not been reported as pests of cotton in the Mississippi Delta, we suspect that the control of tarnished plant bugs and cotton fleahoppers, both known cotton pests, was the major contributing factor to earliness at Scott. We cannot, however, rule out the effects of control of leafhoppers and whitemarked fleahoppers. There were significant differences among varieties in tarnished plant bug infestation, which paralleled the differences in earliness. This supports the assumption that whitemarked fleahoppers and leafhoppers were not important pests but that tarnished plant bugs and cotton fleahoppers were.

Tarnished Plant Bug and *Heliothis* Spp. and Their Predators

The best data on the tarnished plant bug and its predators, *Geocoris* spp. and nabids, are from the Scott and Stoneville locations (table 7). There were always 3 to 12 times more tarnished plant bugs than predators during the growing season.

Egg predators of *Heliothis* spp., lady beetles, *Geocoris* spp., nabids, *Chrysopa* spp., and *Orius insidiosus* were highest in numbers at Scott and lowest at Sumner. However, there were almost no eggs of *Heliothis* spp. on the plants during the time we collected predators with the D-Vac sampler. Predators ranged from zero to 4,358 per acre (1 per 3 row-feet) at peak abundance. The highest populations of *Heliothis* spp. were at Sumner. At this location there were 1,591 predators per acre, with very low egg counts of *Heliothis* spp., on July 13. One week later, egg counts of *Heliothis* spp. were 35 per 100 plant terminals, but only 370 predators per acre were collected. They had not declined because of a shortage of prey. According to R. E. Fye (personal communication), even the highest predator level (1,591) was not enough to significantly affect the population of *Heliothis* spp. Larvae of *Heliothis* spp. reached economic levels at Sumner and Stoneville. Predators or larvae of *Heliothis* spp., *Geocoris* spp., nabids, and *Chrysopa* spp. were almost nonexistent at Sumner. At Stoneville, predators of *Heliothis* eggs and larvae may have been abundant enough to hold the population of *Heliothis* spp. in check. This situation remained at the subeconomic level during July.

Effects of Cotton Varieties on Insect Populations

Lady beetles.—These were the most abundant insects at Scott and Stoneville, followed by Shelby and Sumner (tables 3-6). In three of the locations, lady beetles were reduced in numbers on the two nectariless cotton varieties, although the reduction was significant only at Scott.

Nabids.—The two nectariless cotton varieties had an inconsistent effect on nabids. 'ST 731N' had lower populations of nabids than 'ST 213' at all locations; however, the difference was significant only at Scott. 'DPL 7146N' had higher populations of nabids than 'DPL 16' at two of the locations, with the difference at Stoneville being significant.

Geocoris *spp., cotton fleahopper,* Chrysopa *spp.,* Orius insidiosus, *and leafhoppers.*—The

cotton varieties did not have a significant effect on any of these insects.

Whitemarked fleahoppers.—Cotton varieties at three of the locations did not affect the populations of this insect. Although the populations were low at Shelby, the two nectariless cotton varieties and MoHG had higher populations than the other three varieties.

Cotton fleahopper.—A low population of cotton fleahoppers existed only at Scott, so apparently the cotton varieties did not influence populations. The pilose cottons, 'ST 731N' and MoHG, showed a trend toward increased numbers of this insect.

Tarnished plant bug.—The two nectariless cotton varieties had reduced populations of this insect at three of the locations, with the reductions being significant at Scott and Shelby. At the fourth location, Sumner, not enough tarnished plant bugs were present to measure the effect of the varieties.

Whiteflies.—'ST 731N' and MoHG cottons are moderately to very pilose. At two of the locations, they had significantly more whiteflies than the other cottons. The glabrous leaves of 'Coker 420' did cause reductions in these insects, although the reductions were not significant.

Thrips.—High populations of thrips were found only at Scott and Shelby. MoHG had significantly more thrips than any of the varieties at Scott, but not at Shelby.

Heliothis *spp.*—The major infestation of *Heliothis* spp. was at Sumner. It was associated with high populations of cotton aphids and abundant honeydew. This, we believe, obliterated the effect we should have seen from nectariless cotton. 'Coker 420', with smooth leaves, had significantly fewer *Heliothis* eggs than any other cotton. This agrees with the published data of Lukefahr et al. (1971). MoHG was effective in reducing boll damage by *Heliothis* larvae, as previously shown by Lukefahr and Houghtaling (1969).

CONCLUSIONS

The results from this study demonstrate that for each particular location there can be significant differences in the insect population. For example, predator populations varied from one location to the next and were never consistent.

Insect populations differed on certain cotton varieties, whether or not the variety had received early insecticide treatment. Early insecticide treatment significantly reduced the number of certain beneficial insects and pests.

Tarnished plant bugs reached the economic level at Scott and Stoneville, thus causing a reduction in the amount of lint cotton picked at first harvest in the unsprayed plots. Early spraying controlled tarnished plant bugs in the treated plots. Larvae of *Heliothis* spp. reached the economic level at Sumner in the unsprayed plots, thus suggesting that in this case beneficial insects alone were not able to control *Heliothis* spp. Beneficial insects reached a peak around July 22 in the unsprayed plots. Normally, the second generation of *Heliothis* spp., which is the first generation of economic importance, is expected to occur in the Mississippi Delta approximately July 22-23.

We conclude that one should be cautious in making a general recommendation on insect control in cotton because of the variation in numbers of both economic pests and beneficial species.

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